

## Bay Species

Kathy Hieb, DFG

Annual abundance indices for six representative "bay" species are presented in this article: *Crangon franciscorum*, Dungeness crab, Pacific herring, shiner perch, California halibut, and starry flounder. *Crangon franciscorum* and starry flounder rear in oligohaline and mesohaline salinities (0.5-5.0 and 5-18‰, respectively); the other four species rear in polyhaline salinities (18-30‰). All of these species spawn in the lower estuary or the near-shore ocean area.

The 1996 abundance index of immature *C. franciscorum* was the highest for the study period (Figure 1), with an index similar to other years with high outflow (eg, 1982, 1983). Distribution was centered in San Pablo and Suisun bays in the summer and Suisun Bay in the fall.

In 1996 the abundance of juvenile Dungeness crabs was very low (Figure 2), typical of years with frequent storms. Dungeness crab larvae hatch in the ocean and are pelagic for about 90 days. In years with frequent storms, ocean currents transport the larvae offshore and to the north, far from the near-shore area. Recruitment of Dungeness crab juveniles to the estuary is highly correlated to the number of late-stage larvae in the Gulf of the Farallones (Reilly 1983).

Abundance of young-of-the-year Pacific herring was also relatively low in 1996 (Figure 3). This was somewhat unexpected, as Pacific herring have responded positively to high outflow in the past and broodstock abundance was very high in 1996.

Shiner perch young-of-the-year abundance has been relatively low since 1988, and the low 1996 index continued this trend (Figure 4). Although we do not know what factors control shiner perch abundance in the estuary, there is some evidence that fishing pressure may have contributed to this recent decline.

The abundance of California halibut continued to decline in 1996 from a record high index in 1993 (Figure 5). Our 1996 catch was dominated by 2- or 3-year-old fish (the 1993 or 1994 year class). The 1992 year class, which dominated the 1993-1995 catches, continued to contribute to our 1996 catch.

Although the 1995 and 1996 young-of-the-year starry flounder indices were the highest since 1983 (Figure 6a), there is strong evidence that starry flounder abundance has declined substantially since the 1960s and 1970s. We believe the increased indices in 1995 and 1996 were in part a response to increased outflow. The one-year-old starry flounder index (1995 year class) increased slightly in 1996 (Figure 6b).

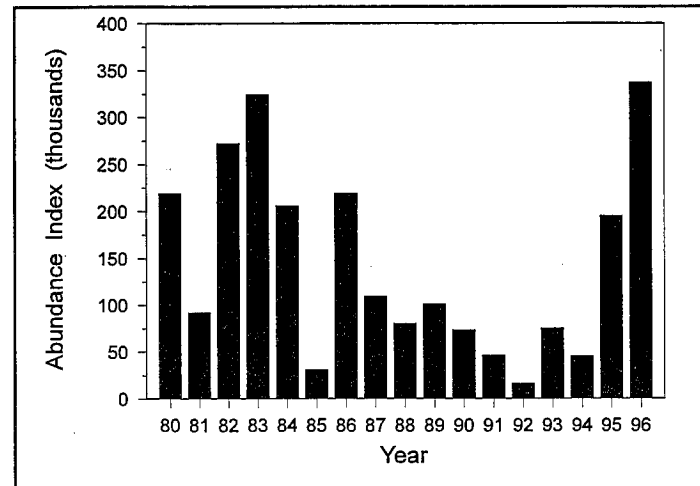


Figure 1  
ANNUAL ABUNDANCE OF IMMATURE *C. FRANCISCORUM*,  
MAY-OCTOBER, OTTER TRAWL

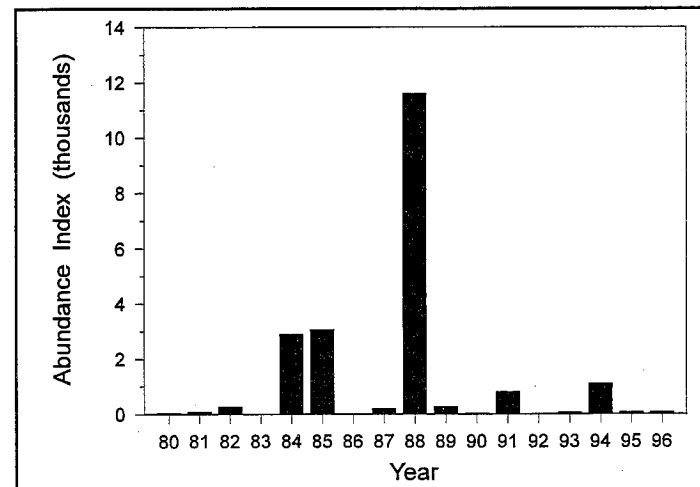


Figure 2  
ANNUAL ABUNDANCE OF 0+ DUNGENESS CRAB,  
MAY-JULY, OTTER TRAWL

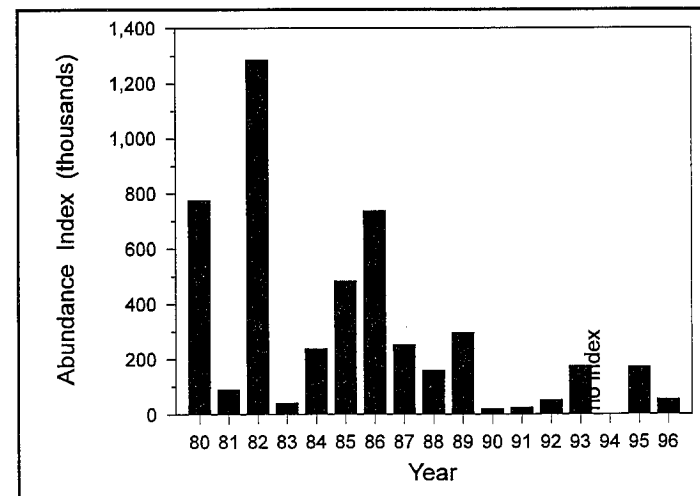


Figure 3  
ANNUAL ABUNDANCE OF YOUNG-OF-YEAR PACIFIC HERRING,  
APRIL-SEPTEMBER, MIDWATER TRAWL  
No index in 1994.

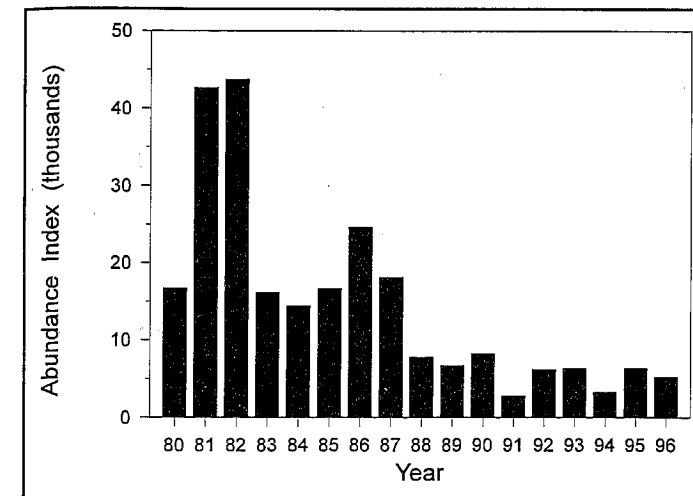


Figure 4  
ANNUAL ABUNDANCE OF YOUNG-OF-YEAR SHINER PERCH  
MAY-OCTOBER, OTTER TRAWL

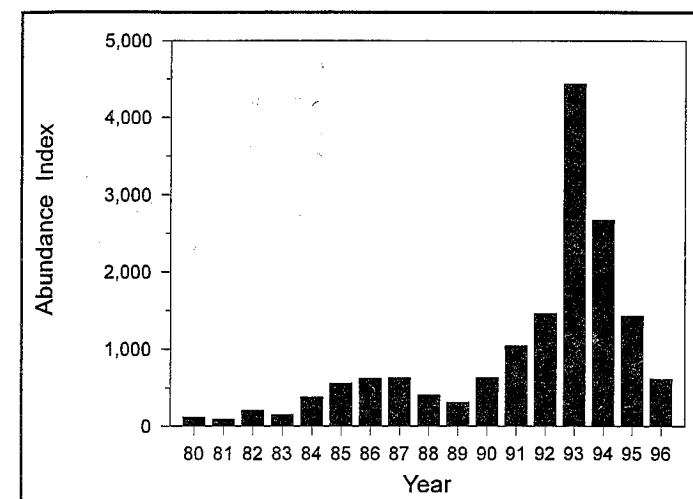


Figure 5  
ANNUAL ABUNDANCE OF CALIFORNIA HALIBUT (ALL SIZES),  
FEBRUARY-OCTOBER, OTTER TRAWL

## Juvenile Salmon Abundance and Survival

Jeff McLain and Mark Pierce, USFWS

Midwater trawling has been done at Sacramento since 1988 to estimate the abundance and timing of juvenile chinook salmon entering the delta.

Figure 1 shows mean catch per 20-minute tow of all salmon at Sacramento in April-June of 1988 to 1996 (comprised mostly of juvenile fall-run chinook). The last two sampling years (1995 and 1996) both wet, show relatively low mean monthly catch per tow. A large portion of the fall-run outmigrant population during these seasons may have entered the delta as fry due to the higher spring flows. This hypothesis is supported by the positive relationship between mean number of fry captured in January-March at historical northern delta seine sites and mean February flow

## Literature

Reilly, P.N. 1983. Dynamics of Dungeness crab, *Cancer magister*, larvae off the central and northern California coast. Pages 57-84. in P. W. Wild and R. N. Tasto, editors. Life history, environment, and mariculture studies of the Dungeness crab, *Cancer magister*, with emphasis on the central California fishery resource. California Department of Fish and Game Fish Bulletin 172.

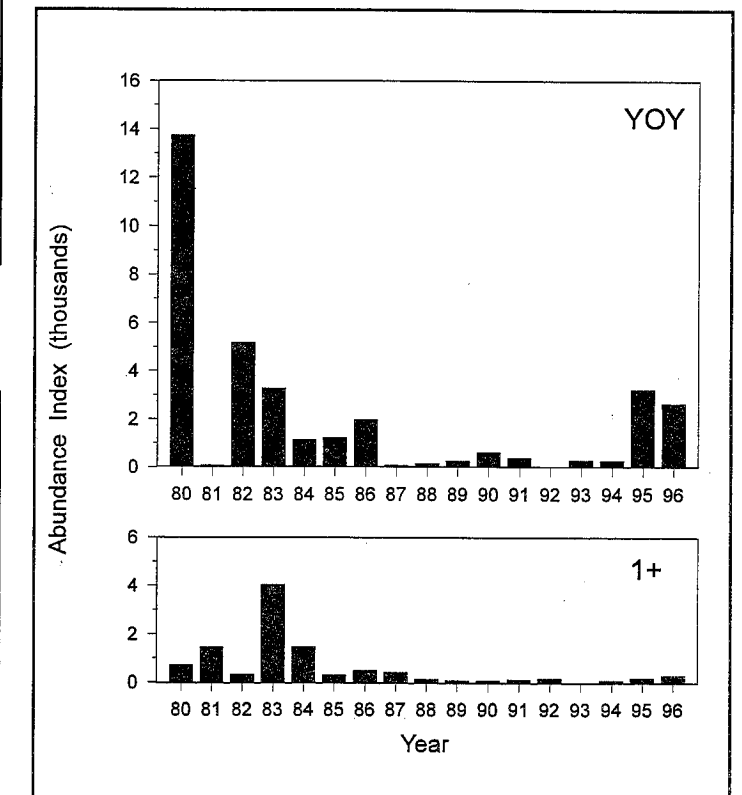


Figure 6  
ANNUAL ABUNDANCE OF STARRY FLOUNDER, OTTER TRAWL:  
a. Young-of-Year, May-October  
b. One-Year-Old, February-October

at Freeport (Figure 2). The 1995 and 1996 seasons fit the historical regression well, showing high catch per cubic meter in years of high February flow at Freeport. The high catches appear to indicate a greater use of the delta in wetter years for rearing of fry.

Annual April-June smolt abundance at Chipps Island (Figure 3) is graphed for 1978-1996. Catches at Chipps Island in 1995 and 1996 were slightly above average for the 3-month period and much higher than in 1994, the lowest catch on record. The wetter hydrology in 1995 and 1996 likely increased juvenile survival upstream and through the delta and contributed to the increased catches.

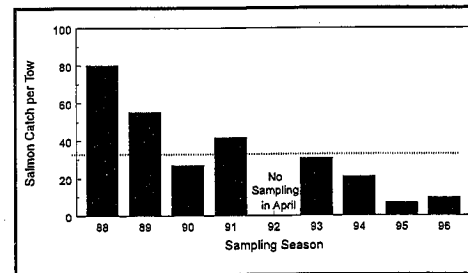


Figure 1  
MEAN CATCH OF SALMON SMOLTS PER  
20-MINUTE TOW,  
SACRAMENTO MIDWATER TRAWL,  
APRIL-JUNE 1988-1996  
There was no sampling in April 1992.  
In 1990, trawling was at Courtland, about 20 miles  
downstream of the Sacramento site.  
Dotted line is the 1988-1996 mean, not including 1992.

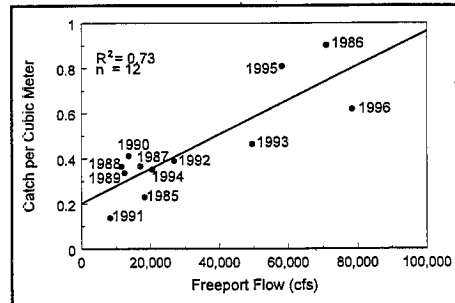


Figure 2  
MEAN CATCH PER CUBIC METER SEINED  
IN THE  
NORTHERN DELTA IN JANUARY-MARCH  
VERSUS  
MEAN FEBRUARY FLOW IN THE  
SACRAMENTO RIVER AT FREEPORT,  
1985-1997

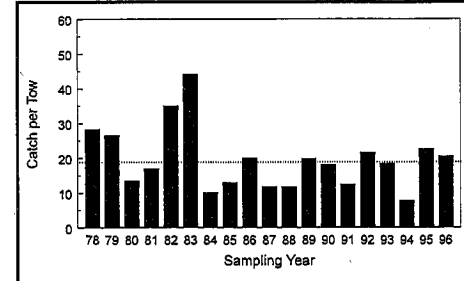


Figure 3  
MEAN CATCH OF SALMON SMOLTS PER  
20-MINUTE TOW,  
CHIPPS ISLAND MIDWATER TRAWL,  
APRIL-JUNE 1978-1996  
Dotted line is the 1978-1996 mean.

Survival through the delta in 1996 was estimated for juvenile salmon using coded-wire-tagged smolts released at Miller Park on the Sacramento River (Table 1) and Mossdale on the San Joaquin River (Table 2) and recovering them in a midwater trawl at Chipps Island.

Releases at Miller Park on April 25 and May 6 yielded a mean survival index to Chipps Island of 0.84 (range 0.58-

1.09). The mean 1996 index is relatively high compared to those estimated historically. Historical indices have ranged from 0.00 in 1978 and 1994 to 1.87 in 1982. The lowest survival indices generally have corresponded to releases made when water temperature was above 70°F. However, the 1990 release was made at 70°F and survived well (0.86), indicating temperature alone is not driving the low survival indices. When release temperatures have been more favorable, the indices have generally been between 0.30 and 1.00.

Survival was indexed for the San Joaquin River in 1996, from Mossdale to Chipps Island, in mid-April and early May. Overall survival was very low for both releases (0.02

Table 1  
SURVIVAL INDICES FOR CODED-WIRE-TAGGED SALMON  
RELEASED AT SACRAMENTO

Release Date	Release Temperature (°F)	Survival Index	Season Average
04/25/96	57	1.09	
05/06/96	65	0.58	0.84
05/01/95	58.5	0.63	0.63
05/03/94	67	0.07	
05/24/94	71	0.00	0.04
04/23/93	61	0.63	
05/03/93	62	0.43	
05/21/93	65	0.35	
05/28/93	64	0.75	0.54
04/25/91	62	0.77	
04/29/91	62	0.50	0.64
05/07/90	70	0.86	0.86
06/01/89	67	0.16	
06/14/89	70	0.20	0.18
05/05/88	62	0.65	
06/23/88	74	0.08	0.37
05/11/82	60	1.87	
06/04/82	68	0.55	1.21
06/04/81	76	0.01	0.01
06/03/80	62	0.32	
06/05/80	62	0.38	0.35
06/06/79	68	0.43	0.43
06/06/78	73	0.00	0.00

Table 2  
SURVIVAL INDICES FOR CODED-WIRE-TAGGED SALMON  
RELEASED AT MOSSDALE

Release Date	Release Temperature (°F)	Survival Index	Season Average
04/15/96	59.5	0.02	
04/30/96	64	0.01	0.02
04/17/95	57	0.22	
05/05/95	62	0.12	
05/17/95	63	0.07	0.14
04/11/94	63	0.00	
04/26/94	60	0.04	
05/02/94	66	0.00	
05/09/94	68	0.02	0.02
04/06/93	64	0.04	
04/28/93	64	0.07	
05/04/93	61	0.07	
05/12/93	65	0.07	0.06
04/07/92	64	0.18	
04/13/92	63	0.12	
04/24/92	69	0.08	
05/04/92	71	0.01	
05/12/92	72	0.02	0.08

and 0.01). Survival since 1992 has rarely exceeded 0.20 in the southern delta. Survival was highest in 1995, with high San Joaquin River flows, moderate exports, and no barrier at the head of Old River. Southern delta survival is extremely low compared to that in the Sacramento River delta.

Releases at Mossdale have been made using smolts originating from the Feather River Hatchery, since smolts from the Merced River Fish Facility were unavailable. To evaluate the possibility that using Feather River Hatchery smolts for south delta survival experiments has biased these estimates low, comparisons of survival through the southern delta were made with smolts from both the Merced and Feather River hatcheries in 1996. Releases from both hatcheries were made simultaneously at Dos Reis on May 1 and at

Jersey Point on May 3 (Table 3). Survival was somewhat improved for the Merced River release groups, although the indices were still very low, with both Dos Reis indices below 0.20.

Table 3  
SURVIVAL INDICES FOR  
MERCED AND FEATHER RIVER HATCHERY  
CODED-WIRE-TAGGED RELEASES IN 1996

Hatchery	Release Site	Release Date	River Temperature (°F)	Survival Index
Feather	Dos Reis	May 1	63	0.02
Merced	Dos Reis	May 1	63	0.10
Feather	Jersey Point	May 3	64	0.35
Merced	Jersey Point	May 3	65.5	0.72

## Chinook Salmon Catch and Escapement

Randall Brown and Sheila Greene, DWR

Much of the following information was taken from the February 1997 report, "Review of the 1996 Ocean Salmon Fisheries" by the Pacific Fishery Management Council. Copies of the report can be obtained by calling 503/326-6352. Additional information was provided by Alan Baracco and Nick Villa of DFG.

The 1996 ocean commercial and recreational fisheries, and escapement of adult salmon not harvested in the ocean and inland fisheries, were affected by management actions to protect the listed winter chinook and the weak

Klamath River stocks. In March 1996, NMFS issued a biological opinion that required ocean take to be reduced enough so that winter chinook spawning escapement would be increased by 35%. The reduction was achieved by regulations implemented south of Horse Mountain, California, to shorten the season, increase the minimum size of legal salmon, and restrict the type of gear that may be used. The 1997 management measures recently released by PFMC will be even more restrictive, with some measures included off California to protect Snake River runs.

Figure 1 — Ocean commercial and recreational catch.

- The total 1996 ocean catch landed in California was about half of that landed in 1995 and was the seventh lowest catch since 1971. The sports fishing fleet, including the charter boats and private boats, was particularly hard hit, landing only about 40% of the 1995 landings.
- The 1996 Central Valley chinook salmon ocean harvest index (ocean catch/catch + escapement) was 0.63, the lowest index in the past 10 years. (In recent years the index has varied between 0.70 and 0.79.)
- The lower ocean harvest index indicates that the relatively low ocean harvest was likely a function of regulatory changes as well as fish availability.
- In 1997, recreational catch may increase due to new regulations, after July 1, that require recreational anglers to keep the first two fish they catch, regardless of size. Last year the minimum size during this period was 24 inches, and many of the hooked fish had to be returned because they were less than the minimum size.

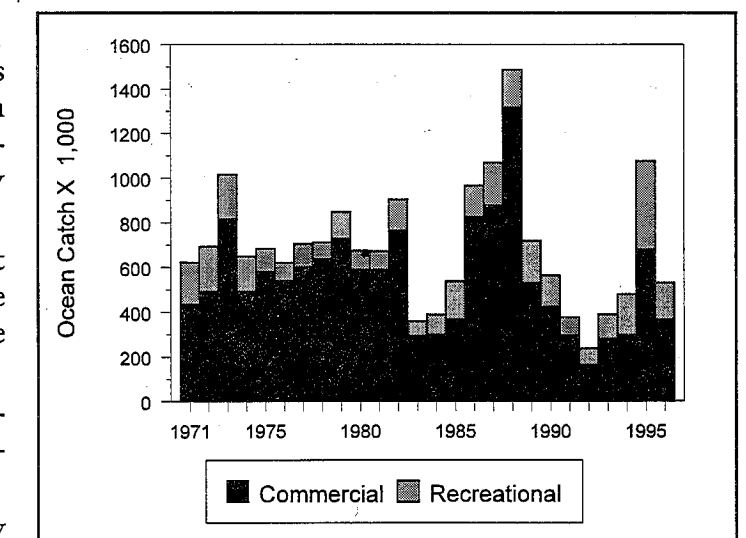


Figure 1  
ANNUAL CALIFORNIA COMMERCIAL AND RECREATIONAL  
CHINOOK OCEAN CATCH  
Preliminary DFG Data